Exam 2

P201 Fall 2006,
Instructor: Prof. Abanov

10/10/06

Name_____ Section_____

(print in **big** block letters)

Your grade:

Problem 1.

An object of mass $m = 2\text{kg}$ is moving along a circle of radius $R = 2\text{m}$ with constant speed $v = 5\text{m}/s$.

How much time does it take for the object to go around the circle? _____

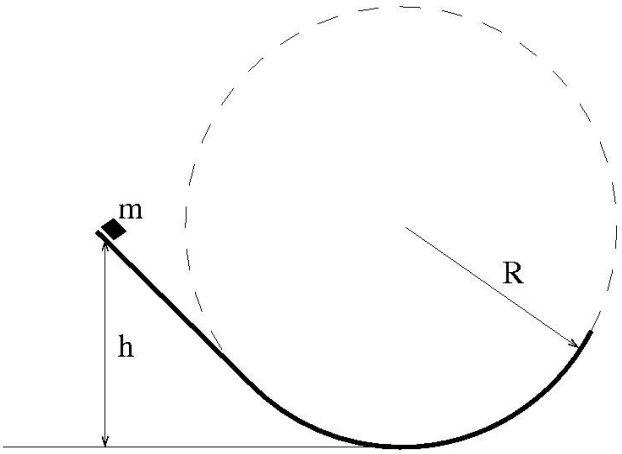
What is the the acceleration of the object? _____

Calculate the force which is needed for the object to move as stated? What is the direction of the force?_____, _____

What force will be needed if we double the radius? _____

Problem 2.

A brick of mass $m = 2\text{kg}$ slides down a frictionless ramp from a hight $h = 2\text{m}$. The ramp at the end bends with radius $R = 2\text{m}$ as shown in the figure.



What is the velocity of the brick at the bottom of the ramp?_____

What is the magnitude of upright force which acts on the brick at the bottom of the ramp?_____

Problem 3.

An earth satellite moves in a circular orbit with an orbital speed of $v = 7000\text{m}/s$.

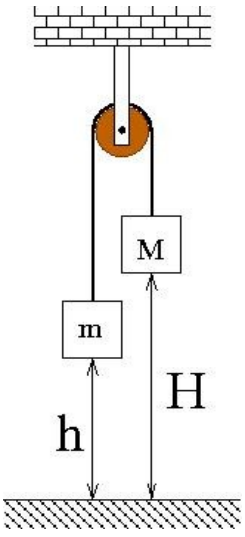
What is the radius of the satellite's orbit?_____

What is the time of one revolution of the satellite?_____

What will be the time of one revolution if the satellite halves its speed? What will be the radius of the orbit in this case?_____,_____

Problem 4.

Two bricks with masses $M = 10\text{kg}$ and $m = 8\text{kg}$ are hanging at the hight $h = 2\text{m}$ and $H = 5\text{m}$ on a frictionless pulley as shown on the figure. At the initial moment everything is at rest



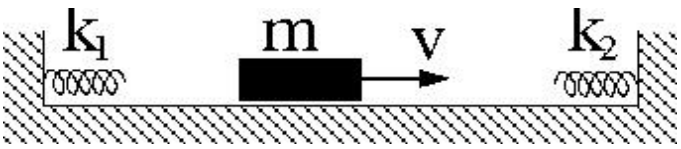
What is the initial energy of the system?_____

What is the potential energy of the system when the brick M hits the floor?_____

What is the velocity of the brick M right before it hits the floor?_____

What would be the velocity of the brick M right before it hits the floor, if 20 Joules of heat were produced in the block due to friction?_____

Problem 5.



A brick of mass $m=2\text{kg}$ has an initial velocity $v=2\text{m}/s$ Two springs with spring constants $k_1=8\text{x}10^4 N/m$ and $k_2=6\text{x}10^4 N/m$ are attached to the walls as shown in the figure.

What is initial energy of the system?_____

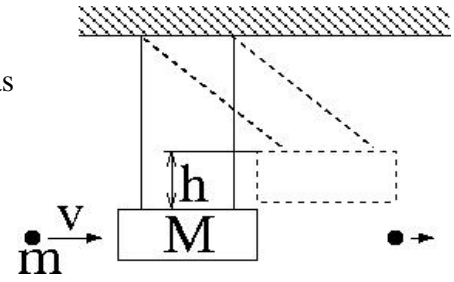
If there is no friction what will be the maximum compression of the springs k_1 and k_2 ?

_____,_____

What would be the answer to the previous question if the mass of the brick were 4 times larger?_____,_____

Problem 6.

A bullet of mass $m=10\text{g}$ has an initial velocity $v=300\text{m}/s$. It goes through a wooden brick of mass $M=3\text{kg}$ which is hanging as shown in the figure. The speed of the bullet on the other side of the brick is half of its initial speed.

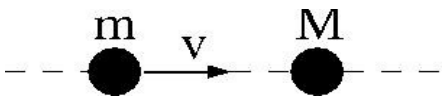


What is the initial momentum of the system?_____

What is the maximum hight h the brick M will get to?_____

How much of the initial energy of the bullet were converted to heat? _____

Problem 7.



A puck of mass $m = 0.4\text{kg}$ and velocity $v = 10\text{m}/s$ collides with and sticks to a puck of mass $M = 0.8\text{kg}$ which is initially at rest.

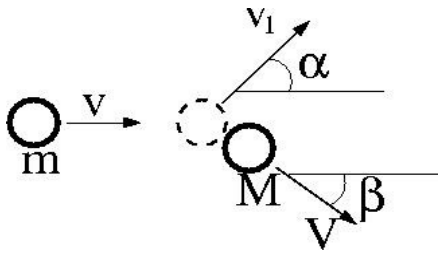
What is initial speed of the center of mass of the two pucks?_____

What is the total initial momentum of the system?_____

What is the final velocity of the two pucks?_____

How much energy has dissipated into heat during the collision?_____

Problem 8.



A puck of mass $m = 0.4\text{kg}$ and initial velocity $v = 2\text{m}/s$ collides with a puck of mass $M = 0.6\text{kg}$ which is initially at rest. After the collision the puck m has velocity $v_1 = 0.5\text{m}/s$ at angle $\alpha = 15°$.

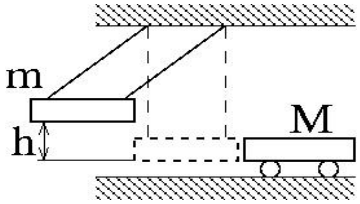
What is initial momentum of the system and kinetic energy of the system?_____,_____

What is the magnitude of the final velocity V of the puck M ?_____

What is the angle β of the velocity V ?_____

What is the final kinetic energy of the system?_____

Problem 9.



A brick of mass $m=3\text{kg}$ is held at hight $h=2\text{m}$ as shown. After it is released it hits a brick of mass $M=6\text{kg}$ at the lowest point of the trajectory. The brick M is initially at rest. The collision is elastic.

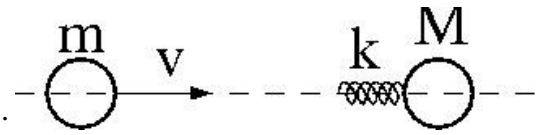
What is the initial energy of the system?_____

What is the velocity of the brick M after the collision?_____

What is the maximum hight the brick m will go after the collision?_____

What would be the answer to the previous question if the brick M were much much much heavier then the brick m ?_____

Problem 10.



An ideal puck of mass $m=0.4\text{kg}$ and initial velocity $v=2\text{m}/s$ collides with an ideal puck of mass $M=0.6\text{kg}$. An ideal massless spring with a spring constant $k=8\text{x}10^4 N/m$ is attached to the puck M as shown.

What is the velocity of the center of mass and initial kinetic energy of the system?_____,_____

What are the velocities of the packs m and M after the collision?_____,_____

What is the total kinetic energy of the system at the moment during the collision when the velocities of the two pucks are equal to each other?_____

What is the maximum squeeze of the spring during the collision?_____